INCORPORATING CROSS-SHORE DYNAMICS IN SHORELINEM FOR THE LONG TERM DEVELOPMENT OF MANGROVE-MUD COASTLINES

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Mangrove forests around the world play a crucial role in creating resilience to climate change and in sequestering carbon. The mangrove forests stabilize coastlines, reduce erosion, increase the biodiversity and protect people along the coast. To model the long-term development of mangrove ecosystems, the transport and deposition processes of sediments around and within these ecosystems is important. A model that is used for modelling this long-term development is ShorelineM. The model uses relatively simple principles of gradient driven alongshore transport and has low computational costs (1-10 minutes). However, the model has shortcomings in the representation of mangroves and cross-shore fluxes need improvements. The goal of this study was to incorporate cross-shore dynamics from MFlat into the 1D longshore model ShorelineM to improve modelling of the long-term development of mangrove-mud coastlines.

The most important limitations in ShorelineM are: the cross-shore distribution and entrainment of sediment; the assumed cross-shore profile and the absence of changes of the shape of the profile in the mangrove zone, which influences the tidal prism and the cross-shore fluxes. The cross-shore profile of the mangrove zone is a uniformly sloped area, whereas in reality convex-up or concave-up profiles are formed. These cross-shore dynamics (profile changes and fluxes) can be resolved by MFlat.

In MFlat, the morphology of mangrove forests is growing towards an equilibrium state based on the given conditions, which in this study is reached after roughly 40 years (for constant boundary conditions and with no mangroves at the start of the simulation). For conditions with a high boundary sediment concentration (c_{bcs} = 0.50 g/l) and a low wave height (H = 0.10 m), the mangrove- and mudflat width after 40 years is almost 3500 m (model domain). For conditions with a low sediment concentration there is almost no mangrove development.

From MFlat, the situation towards the equilibrium (after 40 years) is used to inform ShorelineM. The development of the mangrove- and mudflat width is based on the simulation length of the MFlat simulations. Implementing the width of the mangrove- and mudflat area from MFlat-simulations into ShorelineM improves the development of the mangrove- and mudflat width and capability of ShorelineM to model the coastline development for 40 years. However, as cross-shore dynamics are complex and include multiple processes, more morphodynamic processes or a change of the cross-shore profile should be implemented to further increase the model performance.

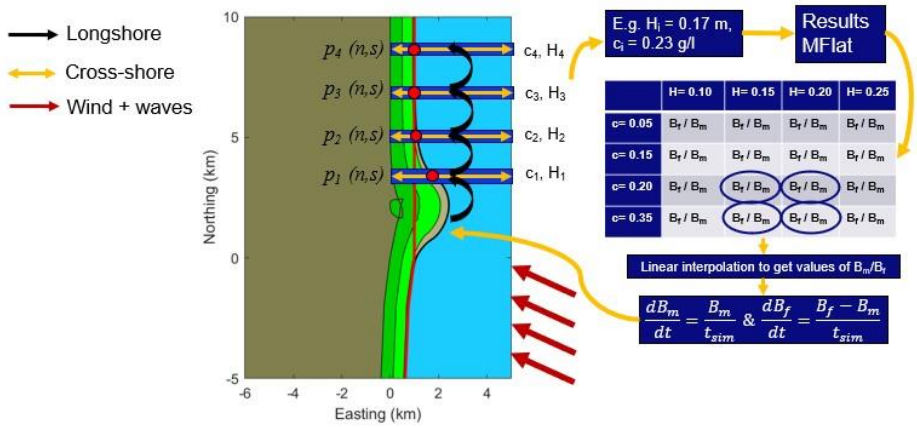

Figure 1. Schematized overview of the coupling of both models. With c_i the concentration and H_i the wave height. The modelled concentration at each cell c_i and wave height at each cell H_i from ShorelineM is used to retrieve cross-shore information from MFlat. The development of the mangroves in ShorelineM is then determined by the information from MFlat.

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